allows us to focus on the questions raised by the WorldCom-MCI merger case and to establish a *prima facie* case that the merger will severely threaten competition in the Internet market.

In order to frame the questions about the competitive effect of the WorldCom- MCI merger, the next section of this paper begins with a short review of the Internet's network structure. This section discusses some of the difficulties in making a competitive analysis of a network, which is further complicated in this case by a commercial culture of secrecy and the vertical integration of the key participants in the merger. The following sections of the study then examine evidence on the key questions raised by this merger:

1. What is the market structure of the Internet?
2. What is the appropriate measure of Internet market share and market concentration?
3. Does WorldCom's and MCI's control over Internet Protocol addresses lock-in Internet Service Providers and create the conditions for the exercise of market power?
4. Does the ownership of the two largest NAPs, MAE East and MAE West, confer potential market power on an integrated WorldCom-MCI?
5. Has there been any overt or tacit collusion between or among WorldCom, MCI, and Sprint in signing interconnection contracts, canceling peering agreements, or inhibiting new peering arrangements?
6. Will the merger of WorldCom and MCI create a duopoly (with Sprint) in the provision of Internet Backbone service and the underlying network transmission facilities?

This paper evaluates the evidence on each question. Unfortunately, the currently available public information is not conclusive. However, the Internet is too important to our national information infrastructure to allow the merger to proceed in an information vaccum, especially since the information does exist and can be collected. We should not take the chance that one company will dominate the future development of the Internet. Before allowing the merger to either proceed or deny it, the Justice Department and the FCC will need to decide

whether the merger is likely to create or enhance market power or facilitate its exercise. To reach a decision the agencies must overcome the secretive commercial culture to investigate the Internet's economic structure. At present, the Hart-Scott-Rodino documents obtained by the Justice Department's antitrust review provide the only window into the culture of secrecy surrounding the Internet's economic structure.

The Internet

Network of Networks - A Brief Review

The Internet is a network of networks that uses a common communications protocol, TCP/IP (Transmission Control Protocol/Internet Protocol) to provide a common language for interoperation between computer networks (McKie Mason and Varian 1997). The technical protocols form the foundation of the Internet; they permit virtually any network to interconnect and to share data with other networks through the Internet. In contrast to telephony, which relies on switched circuits that are set-up for the duration of a call, the Internet uses a connectionless adaptive routing system, where no dedicated end-to-end channel is established for each communication. Instead traffic is split into 'packets' that are routed among multiple points making the Internet an interconnected global network of packet switched networks using the Internet protocol (Werback 1997).

The Internet functions as a series of layers. It is built on top of telecommunications network facilities and services. The structure of the Internet comprises six basic entities: end users, Internet Service Providers (ISPs), Internet Backbone Providers (IBPs), Network Access Points (NAPs), private interconnection agreement, and the telephone Interexchange Carriers (IXCs). End users most often gain access over telephone lines provided by their Local Exchange Carriers either through individual connections with an Internet Service Provider or through computer networks in organizations such as universities and businesses, which may directly connect to Internet Backbone Providers using dedicated lines. Internet Service Providers, such as America Online, Compuserve, and Microsoft Network (MSN), connect end users to the

Internet backbone networks. The Internet Backbone Providers, such as MCI, WorldCom's UUNet, and Sprint, route traffic between ISPs, and interconnect with other backbone providers at Network Access Points. The Network Access Points, also called public peering centers, provide the foundation of the Internet. They are the nodes where the networks interconnect and exchange traffic and routing information. Increasingly, traffic is exchanged at private peering points. Undergirding the Internet backbones and NAPs are the telecommunications facilities, private high speed lines, and network services leased from major interexchange carriers, such as, WorldCom, MCI, and Sprint.

The Internet Is Also a Network of Secret Commercial Agreements

The Internet is also built on layers of commercial agreements. While many Internet end users enjoy the widely available $19.95 flat rate Internet access price, above the ISP retail level, prices, settlements, and interconnection agreements are increasingly viewed as proprietary and are contractually restricted from public disclosure (Srinagesh 1997). In 1995, when federal support for the NSFNET backbone ended, the Internet consisted of a number of relatively equal size commercial backbones that exchanged traffic without fees at Network Access Points, a process known as "peering." The NSF through competitive contracts developed the major regional Network Access Points. Three priority Network Access Points were established in Northern California, Chicago, and New York and others, such as MAE-East and MAE West (created by MFS, now owned by WorldCom) were also created to replace NSFNET and to facilitate the interconnection of commercial backbone providers. Backbone providers may enter interconnection agreements at Network Access Points (NAPs), but they are not required to enter into any agreement (Bailey 1997).

During 1996, open peering ended as incumbent backbones refused to establish new peering arrangements with new comers that did not match their size and traffic load (Cook Report 1998). In May 1997, UUNet in concert with Sprint, announced the end of free peering. New peering arrangements from the major backbone providers are now almost impossible to get,

instead a transit fee is required. Six major backbones, however, still peer with each other and interconnect at most of the major NAPs (Cook Report 1998); however, three of them will become a part of the merged WorldCom-MCI. Internet Service Providers and dedicated access customers contract with upstream providers for interconnection to the Internet. They pay a monthly fee for their Internet backbone connection, which includes a promise to deliver packets anywhere on the global Internet. If their backbone provider is not a major backbone, such as Sprint, MCI, or UUNet, their backbone provider will most likely pay a fee to interconnect with the global Internet through a major backbone provider (Cook Report 1998). A hierarchy of commercial contracts has evolved that place the major backbone providers at the center of global interconnectivity. Increasingly the terms of these contracts are proprietary and not subject to public disclosure (Srinagesh 1997). Many Internet backbone providers have entered into long term agreements to lease their underlying telecommunications network facilities and services from major interexchange carriers; these contracts also are often not subject to public disclosure.

The result is a pyramid of undisclosable commercial contracts. Yet, it is in the process of commercial contracting where potential abuse is most likely to occur, where market power is most likely to be exercised, and where the Internet is most vulnerable to failure. It is the network interconnection points that are the glue of the Internet. If interconnection is prone to market failure, "then the glue may dissolve and the distributed nature of the Internet may yield to monopoly or oligopoly provision and transport" (McKnight and Bailey 1997b). The secrecy surrounding the Internet's operation and the terms of interconnection stands in sharp contrast to the data and information routinely available about the telephone network. Economic analyses of the Internet often lack agreement on terms, definitions, measures, and methodologies. For example, published estimates of 1997 revenue for Internet services vary widely: $4.2 billion (Frost and Sullivan 1997, 3-8), $4.6 billion (International Data Corporation 1997, 15), and $8.4 billion (Maloff Group 1997, 7).

Further complicating the process of analysis is the vertical integration of the major Internet providers. MCI offers dial-up and dedicated Internet access to end users, provides

upstream services to ISPs, connects more ISPs to its nationwide backbone than any other Internet backbone provider, and leases its private telecommunications facilities to ISPs and Internet backbone providers. WorldCom is a leader in supplying dedicated Internet access to businesses; it also connects America Online, Compuserve, and Microsoft Network to the Internet under long term exclusive contracts; it already owns three major backbones, UUNet, ANS, and Compuserve and administers five Network Access Points including two major NAPs, MAE- East and MAE-West; and WorldCom is the leading supplier of telecommunications facilities leased by Internet Service Providers and Internet Backbone Providers. This vertical integration has the potential to obscure the sources of revenues and profits from outside detection through an integrated firm's use of internal pricing and transfers.

Internet Network Economics

The economic analysis of competition among Internet Service Providers and Internet Backbone Providers is greatly complicated by the presence of network externalities, scale economies, and excess capacity or under capacity, and congestion. Networks exhibit positive consumption and production externalities (Economides 1996). Consumption externalities arise because every communication involves at least two parties, the originator and the receiver. A decision by one person to contact another can generate an uncompensated benefit (or cost) for the contacted party, creating a consumption externality. Production network externalities arise because the private benefit to any one individual of joining a network, as measured by the value he or she places on communicating with others, is less than the social benefits to all other subscribers of communicating with him or her. Again, the subscription decision creates benefits that are not compensated through the market mechanism. Prices chosen by competitive markets are not economically efficient when externalities are present (Gong and Srinagesh 1997). Perfect competition will provide a smaller network than is socially optimal (Economides 1996).

Firm's operating in network production processes are often subject to economies of scale. They invest in a costly communications network which represents a substantial sunk fixed cost

embedded in long-lived facilities with excess capacity. Once the network is constructed the marginal cost of another communication is essentially zero (Gong and Srinagesh 1997). The standard competitive standard that prices be set equal to marginal costs is a recipe for bankruptcy (Baumol and Sidak 1994). At the very bottom of the Internet's hierarchy of networks are the physical resources used to construct the links based on the telephone network. Switches, multiplexors, and fiber optic networks create the point-to-point channels, where scale economies and sunk costs are substantial (Gong and Srinagesh. 1997).

Large network service providers, such as MCI, WorldCom, and Sprint have invested in fiber networks necessary to deliver point-to-point services; each has had substantial excess capacity. Their cost structures include construction costs, fees for rights-of- way, equipment costs for lasers, fiber cable, electronics, switches, multiplexors, costs for interconnection and negotiating interconnection agreements, marketing and sales costs, the costs of provisioning, credit checks, and billing, costs of maintaining and monitoring the network to assure service, costs of terminating customers, and general administrative costs. The incremental costs of carrying traffic is zero, as long as there is excess capacity. Marginal cost pricing would result in all facilities based carriers going out of business (Gong and Srinagesh. 1997). The standard competitive model cannot aid us in a network analysis of the Internet.

Furthermore, when excess capacity is depleted the facilities based carriers can reap windfall profits. Internet traffic flow is now routed on the first come, first served principle. When there is inadequate capacity, any scarcity of Internet bandwidth results in delays due to network congestion. The cost of congestion is measured in delays and lost packets. A frequently proposed alternative to the first-come first serve principle is peak load pricing, which seeks to balance traffic volume with capacity by permitting carriers to raise prices to alleviate congestion. This dynamic pricing system, however, creates opportunities for abuse. A usage sensitive pricing scheme creates incentives for firms that control bottleneck facilities to engage in anti competitive behavior by inducing congestion to raise prices and reap the increased earnings

(Sarkar 1997). Any economic analysis of the Internet must also address the incentives and opportunities of firms to capture bottleneck facilities.

Mergers, Markets, and Market Power: WorldCom and MCI

Basically, there are two ways that a merger that increases market concentration can have adverse effects. First, a merger that increases a firm's market share, can increase a firm's ability to engage in the unilateral exercise of market power. Second, a merger that increases market concentration may increase the ability of a group of firms to engage in a coordinated exercise of market through either overt or tacit collusion (Rosenberg 1997).

The assessment of market concentration, potentially adverse competitive effects, market entry, efficiency and failure are tools used to determine whether a merger is likely to create or enhance market power or to facilitate its exercise. Market concentration is often the starting point. It is a function of the number of firms in a market and their respective market shares. Commonly used measures of market dominance include concentration ratios and the Herfindahl-Hirschman Index (HHI), which is the sum of the squared market shares of all firms in the market. The Department of Justice and Federal Trade Commission 1992 Merger Guidelines defines three broad ranges of market concentration, as measured by the HHI. These are: unconcentrated -- an HHI below 1000; moderately concentrated -- an HHI between 1000 and 1800; and highly concentrated - an HHI greater than 1800. One implication of this classification system is that a market would be classified as highly concentrated if the single largest firm's has a market share of 43% or more. Where the post-merger HHI exceeds 1800, it will be presumed that mergers producing an increase in the HHI of more than 100 points are likely to create or enhance market power or facilitate its exercise.

Market shares are calculated using the best indicator of the firms' future competitive significance. Dollar sales are used if firms are distinguished primarily by differentiation of their products. Unit sales are used if firms are distinguished primarily on the basis of their relative advantages in serving different buyers or groups of buyers. Physical capacity or reserves are

used if these measures most effectively distinguish firms. Unfortunately, the publicly available data on the Internet yield a wide range of market share estimates, none of which are entirely satisfactory.

There is also substantial disagreement about the market structure of the Internet. WorldCom and MCI vigorously deny that there is a separate Internet Backbone market. Most independent observers (*Boardwatch, Cook Report*, Werback) and WorldCom-MCI's critics (GTE, Bell Atlantic, CWA, United States Internet Providers Association) believe there is a separate Internet Backbone Provider market. The significance of this disagreement is that if a separate Internet Backbone market exists, then according to the Merger Guidelines on market concentration, the proposed merger will create a company that can be presumed to dominate that market. Thus, the outcome of the FCC and Justice Department reviews of the anti-competitive implications of the proposed merger may hinge on determination of whether the Internet backbone provider and Internet service provider markets are distinct.

WorldCom and MCI Estimated Changes in Internet Market Concentration

Numerous estimates of market share changes resulting from the proposed merger between MCI and WorldCom have been developed. Two characteristics of these estimates stand-out. First, none of these estimates conform precisely with any of those requested by the Justice Department to measure market share. Second, the market share estimates vary greatly. On the low side, MCI and WorldCom report market share data that indicate that the merged company would hold only a 20% share of Internet market revenue and traffic, indicating an unconcentrated market place that does not need regulatory review. All other estimates of market share are in the 48% to 68% range and indicate that a merger would result in a highly concentrated Internet Backbone market, increasing the HHI more than 100 points, which is presumed to create or enhance market power or facilitate its exercise. See Table 1 below.

Table 1: Summary of Estimates of the Merged WorldCom-MCI Internet Market Share		
Source	Measure of Market Share	Merged WorldCom-MCI Concentration Ratio
BoardWatch Magazine June 1997	WorldCom MCI Backbone Connections as a Percent of Total Backbone Connections with ISPs	55%
BoardWatch Magazine ISP Fall Directory, Fall 1997	WorldCom MCI Backbone Connections as a Percent of Total Backbone Connections with ISPs	48%
BoardWatch Magazine June 1997 In Comment of Communications Workers America 1/5/98	Percent of ISPs Connecting to the WorldCom MCI Backbones	63%
Maloff Group October 1997	Percent of Internet Revenue Connecting over the WorldCom MCI Backbones	68%
Maloff Group October 1997 Revision	Percent of Internet Revenue Connecting over the WorldCom MCI Backbones	62%
Bell Atlantic January 1997	Summary of Expert Estimates of Market Share Reported in the Press	60%
Bell Atlantic January 1997	Estimate of Share of Customer Routes using Router Tables	58%
MCI WorldCom January 1997	Revenue Share Estimate	20%
MCI WorldCom January 1997	Estimate of Share of Customer Routes using Router Tables	20% or 22%

The market differences in part reflect the substantial disagreement about what constitutes an appropriate market and where the market boundaries are. Is there a separate and identifiable Internet Backbone Provider market? WorldCom and MCI tell us there is no separate backbone market. Instead, they should be judged as Internet Service Providers. In contrast, most independent observers believe there is a separate and distinguishable Internet Backbone Provider market place.

WorldCom - MCI Internet Market Share Calculations. Arguing that revenues provide the strongest indicator of market share, WorldCom and MCI estimate that their combined Internet market share would be approximately 20 percent. They obtained this figure by taking the total 1996 Internet industry revenue figure of $2.3 billion estimated by Frost & Sullivan (1997) and doubling it, in line with analyst growth estimates. They then applied their 1997 Internet revenue estimates for MCI and WorldCom to that base figure (WorldCom and MCI 1998). This exercise yields a 1997 Internet revenue figure of $920 million for the combined WorldCom and MCI. However, this self-reported revenue estimate appears to be much too low. Checking publicly available sources (SEC filings, *Boardwatch Magazine* and MCI Internet Vision Statement), we estimate Internet revenue estimate for a combined WorldCom and MCI is at least $1.5 billion, which yields a lower bound market share estimate of 32%, using their methodology of doubling Frost and Sullivan 1996 Internet revenue figure as the base. The reliability of both of these estimates is open to dispute. Since no independent publicly available source reports a combined revenue market share for a merged WorldCom-MCI, there needs to full disclosure of the Internet revenue data by WorldCom and MCI by market segment.

Bell Atlantic argues that Internet Backbone market concentration should be calculated on the basis of ownership of routes on the Internet. On this basis, Bell Atlantic concluded that 58% of routes to customers on the Internet would be owned by the merged company. WorldCom and MCI claim this figure is too high. They report their analysis yielded a share of aggregate route entries between 20 and 22 percent (WorldCom and MCI 1998). In contrast to the disagreements about market share, this dispute about route entries could be resolved and verified by any party that has access to the route entries. Engineers working on the Internet, not affiliated with any party involved in this merger process, could provide an independent count of the percent of route entries that would be controlled by a merged WorldCom and MCI, and should be asked to do so by the regulatory authorities.

***Boardwatch* Internet Market Share Estimates.** *Boardwatch* reports the number of Internet service providers who have connections to each of the major backbones (Table 2). The table counts only ISP connections and indicates market share among ISPs only; it does not include commericial, government, university, or non-profit Internet users who get dedicated access to the Internet. *BoardWatch* claims, however, that they analyzed Internet traffic data patterns, which they state matches overall ISP market shares to within hundredths of a percent with the exception of IBM Global Networks. IBM has some 30,000 business customers, and almost no ISPs . They believe their data does represent true relative share sizes.

The June data are from 3,852 ISPs with a total of 4,455 connections. They indicate that each ISP averages 1.16 connections to backbones. The Fall *Boardwatch* data show that while there were some 4,354 Internet service providers, they had 5,739 separate links to backbones. This, again, makes sense since some ISPs connect to several backbones, but the overall majority of ISPs have only one backbone link. MCI remained the leader with 1,689 connections. This represents 29.43 percent of the 5,739 connections, while 39 percent of the Internet service providers connect to MCI. Sprint was second with 1,298 connections or about 23 percent of all connections. UUNet, with the newly acquired ANS and CompuServe backbones, has a total of 1,091 connections, which is 19 percent of all connections. If WorldCom does acquire MCI, it would own 48 percent of all Internet ISP connections. The data are less clear about what total percentage of ISPs would be connected to a merged WorldCom-MCI, since there is some overlap among UUNet, ANS, CIS, and MCI among ISPs, but it would significantly exceed 50%. In other words, over half of the ISPs would get a backbone connection through a merged WorldCom-MCI.

Table 2: Shares of Internet Backbone Connections by Internet Service Providers

Source: Boardwatch Magazine	*June 1997*	*June 1997*	*Fall 1997*	*Fall 1997*
Backbone Providers	Connections	% of Total Connections	Connections	% of Total Connections
WorldCom-MCI	2454	55%	2780	48%

MCI	1569	35%	1689	29%
Sprint	1176	26%	1298	23%
UUNET/CIS/ANS	885	20%	1091	19%
AGIS	303	7%	354	6%
BBN	189	4%	234	4%
Total Connections	4455		5739	

The June *BoardWatch* data, which are used by CWA (1998) in its FCC Comment, probably overstate the effect of the merger, when CWA simply adds up the MCI and WorldCom ISPs (Table 3). The combining of MCI, UUNet, ANS, and CIS, ISP connections omits the overlap among the backbones, since some providers have more than one connection. Carlton and Sider (1998) correctly criticize the double counting of ISPs inherent in this approach, which does overstate the effect of the merger. However, CWA's approach does indicate how pervasive this proposed combination will be, serving over half of the ISPs in the market. And if *BoardWatch* is correct that their data reflect patterns in the overall Internet market, the combination will serve over half of business customers and others that rely on dedicated access to reach the Internet.

Table 3: Internet Service Providers Connections

Source: Boardwatch Magazine	*June 1997*	*June 1997*
Backbone Providers	Connections	% ISPs Connecting
WorldCom-MCI	2454	68%
MCI	1569	41%
Sprint	1176	31%
UUNET/CIS/ANS	885	23%
AGIS	303	8%
BBN	189	5%
Total Connections	4455	

WorldCom and MCI (1998) and Carlton and Sider (1998) point out that the number of ISP connections has no necessary relationship to the availability of network capacity or the ability of backbone suppliers to expand the provision of services and constrain price. And they are correct when they state that the *Boardwatch* calculations based on ISP connections alone do not incorporate information on non-ISP customers, such as direct customer connections to backbone providers. Yet, they fail to refute *BoardWatch's* claim that Internet traffic data match overall ISP market shares to within hundredths of a percent. The major advantage of these measures is that *BoardWatch* did the counting and performed the calculations, not MCI, WorldCom, or their critics. Additionally, this estimate of a merged MCI-WorldCom market share of the Internet can be independently verified.

The Maloff Report Market Share Estimates. According to the Maloff report the U.S. Internet access market place had revenue of $8.4 billion in value in October 1997 (Maloff 1997). This number is considerably higher than other published market studies. The report was able to identify 5,121 ISP nodes in the U.S. serving 877,650 dial up ports and 19.2 million dial-up customers. MCI was mentioned most often as the leading backbone providing access to smaller ISPs, followed by Sprint and UUNet. During the past year, Maloff reports that WorldCom (owner of UUNet, GridNet, and MFS) moved to acquire ANS from AOL, CompuServe's Network Services Division, and MCI. At the same time, UUNet quietly became the underlying carrier for WebTV, Earthlink, and Microsoft Network. AT&T and Sprint largely missed the market.

Using the share of industry revenue generated by Internet service providers that would connect through WorldCom-MCI as the measure of market share, a combination of AOL, ANS, CompuServe, UUNet, and MCI provides WorldCom with 56.7% market share according to the report. Maloff includes AOL in this number because of their long-term (five-year) arrangement for network services from WorldCom, and because AOL's Steve Case holds a seat on the WorldCom Board of Directors.

Microsoft Network and Earthlink are two other large ISPs that obtain their Internet connectivity from UUNet, which yields a 68.3% market share according to the Maloff Report. If we add Concentric, the seventh largest ISP, which currently obtains its Internet backbone connectivity from both MCI and WorldCom, the MCI-WorldCom combined market share estimate is 71.5%, using the Maloff Report data.

Table 4: IP Revenue Connecting to the Internet through WorldCom-MCI Backbones		
Source: Maloff Report October 1997		
Internet Providers	Revenue	Proportion of Internet Revenue
WorldCom-MCI	$5,228	62%
	Revenue Source	Proportion of Internet Revenue*
ANS	$88	1%
Concentric	$246	3%
UUNET	$351	4%
MCI	$134	2%
Earthlink	$104	1%
America OnLine	$2,160	26%
CompuServe	$1,406	17%
MSN	$739	9%
Total U.S. IP Access	$8,430	

The Maloff Report indicates that up to 72% of the Internet revenue generated by Internet providers would connect through WorldCom-MCI. These estimates appear to be on the high side. Our own recalculations based on the Maloff Report data would suggest that 62% of the Internet revenue would gain Internet connection through WorldCom-MCI. While the lack of accurate publicly available data makes it difficult to have confidence in a precise number, the

analysis makes clear that a preponderance of Internet service providers would connect through the merged company.

Bell Atlantic's Estimate of the Merged WorldCom - MCI Market Share. Bell Atlantic claims that a merged WorldCom MCI will control over half the Internet. Bell Atlantic summarizes expert estimates of the post-merger Internet market share reported in the press (presented in Table 5 below). Bell Atlantic concludes that the HHI, measure of market concentration, reveals an alarming loss of competition in the market. On average, the post-merger HHI is twice that identified in the Merger Guidelines as indicating a market which is "very concentrated."

Table 5: Bell Atlantic's Estimates of Market Concentration in the Internet Backbone Following a WorldCom/MCI Merger

Estimate By Source	POST-MERGER MARKET SHARE	MINIMUM HHI
Boardwatch Magazine Survey Jon Healey, "MCI Bid Puts Net at Stake," *San Jose Mercury News* (10/2/97)	51%	2601
Information Week Mary Thyfault & Beth Davis, "Users Assess WorldCom's $30 Billion Bid for MCI," *Information Week* (10/6/97)	49%	2401
Industry experts George Mannes, "Wall St. WorldCom Beater, Internet Worries Linked to Prices," *New York Daily News* (10/3/97)	"up to" 80%	6400
Decision Resources, Inc. "WorldCom Tops Its $20 Billion, 20 Month Spending Spree With a $30 Billion Bid for MCI," *PR Newswire* (10/3/97)	"at least" 60%	3600
Inter@ctive Week Wilson & R. Barrett, "Proposed Colossus Craves International Reach," *Inter@ctive Week* (10/6/97)	"more than" 50%	2500
Wall Street Journal Thomas E. Weber and Rebecca Wuick, "Would WorldCom-MCI Deal Lift Tolls on Net?" *Wall Street Journal* (10/2/97)	"more than" 60%	3600

Arlen Communications "Rival's Bid for MCI Nearly $30 Billion," *Sacramento Bee* (10/2/97)	"over" 70%	4900
MEAN	**60%**	**3600** **(3715)***

***Mean of calculated HHIs, as opposed to HHI calculated from mean of market share estimates.**

The reported market share estimates range from 49% to 80%. By averaging the reported expert estimates, Bell Atlantic concludes that a post-merger WorldCom-MCI would possess a 60% Internet market share. Replicating these results is complicated by the lack of independently available and verfiable data. On this question, we did a thorough search of resources available on the Internet and found they echoed the estimates reported by Bell Atlantic.

Summary and Conclusions about Market Share Information. MCI and WorldCom present data indicating the post merger firm would operate in an unconcentrated Internet market place earning 20 percent of the Internet's revenue and carrying 20 to 22 percent of the Internet's traffic. In contrast, critics and independent observers present a series of estimates that indicate that the post-merger firm would create a highly concentrated Internet market structure with estimates ranging from 48% to 68% of Internet traffic and revenue under the control of MCI and WorldCom largely through their control of the Internet Backbone Provider market place. If these estimates accurately reflect the current Internet economic structure, there is a strong need for government involvement in the merger since it must be presumed by the Justice Department's Merger Guidelines that merger is likely to create or enhance market power and enhance its exercise.

Further analysis is warranted before regulators approve the merger. The Justice Department and the FCC should require WorldCom and MCI to fully disclose their Internet revenues, their interconnection backbone agreements, their peering agreements, their contracts with Internet Service Providers, their contracts with dedicated access customers, their

administrative procedures and agreements at their Network Access Points, and their Private line, facility, and service agreement to provide telecommunications services to Internet Service Providers and Internet Backbone Providers. In addition, the FCC and the Justice Department should call upon the Internet engineering community to resolve disputes over traffic flow, traffic volume, ISP connections, and overall traffic patterns and what proportion the merged company would control. Possibly, Merit or some other NSF funded research center could provide these answers.

Does the Merger Create Bottlenecks, Lock-Ins, and Tacit Collusion?

The economic analysis of networks focuses our attention on problems arising from interconnection agreements. Through a pyramid of commercial contracts the major backbone providers are placed at the center of global interconnectivity. The terms of these contracts are proprietary and not subject to public disclosure. Yet, it is in the process of commercial contracting where potential abuse is most likely to occur, where market power is most likely to be exercised, and where the Internet is most vulnerable to failure. It is the network interconnection points that are both the glue of the Internet and mostly likely to yield to monopoly or oligopoly provision and transport" (McKnight and Bailey 1997b). Particularly, the control over bottleneck facilities creates conditions where a firm can engage in anti competitive behavior (Sarkar 1997)

Bell Atlantic and others argue that the merger of MCI and WorldCom will create and exacerbate bottleneck control and lock-in costs that will enable the exercise of market power and tacit collusion by the post merger WorldCom-MCI. The argument is that three conditions would allow a merged WorldCom-MCI to exercise market power that will result in higher prices for Internet service. First, ISPs face technical obstacles in switching Internet Backbone Providers since there is no general portability of IP address space. Secondly, the backbone providers connect their networks at major network access points" (NAPs). WorldCom owns five NAPs, including the two dominant NAPs, and at private exchange points. MAE East and MAE West.

These unregulated bottleneck points could give WorldCom crucial leverage over other Internet backbone providers. Thirdly, the behavior of UUNet and Sprint in May 1997, when they announced the cancellation of numerous peering agreements with ISPs, and the current limitations placed on new entrants in negotiating peering agreements can be interpreted as anti-competitive and tacitly collusive behavior. Alleged tacit collusion has been occurring in the pricing of publicly switched long distance service among AT&T, MCI, and Sprint (MacAvoy 1996); that alleged behavior could be easily replicated in the pricing of Internet Backbone services by WorldCom-MCI and Sprint. In addition, ISPs may have little incentive in terms of price or quality to switch backbones once WorldCom and MCI merge, since most Internet traffic will travel across segments of WorldCom. The combined company could thus control the terms and conditions by which everyone's traffic is transported across the Internet either through access or interconnection. Each of these allegations will be summarily presented below along with the summarized responses by WorldCom, MCI, and their experts and then subjected to a critical evaluation.

Internet Protocol (IP) Addresses and ISP Lock-in Costs. Bell Atlantic (1998) argues that the lack of portability of Internet Protocol (IP) address space provides substantial lock-in costs to ISPs that may face price increases or quality degradation by a merged WorldCom and MCI. This position is reinforced by the United States Internet Providers Association (1998, withdrawn). Over 90% of ISPs currently obtain IP address space by leasing address space directly from their upstream provider (Bell Atlantic 1998). IP block allocations are strictly controlled by the American Registry for Internet Numbers (ARIN). The ISPs who lease rather than own address space face almost insurmountable obstacles to switching backbones. To switch, they must be assigned new IP addresses and engage in the burdensome and time-consuming task of renumbering their networks and systems and the networks and systems of all their customers. Renumbering creates substantial dangers of disruption and customers losses, and creates customer service problems and expense (USIPA 1998). Forced renumbering can be

used as a means to lock-in clients into a particular backbone provider. MCI and WorldCom, as the largest Internet Backbone Provider, will own a substantial IP block allocations which will give them considerable market power in pricing its Internet Backbone services.

WorldCom and MCI dismiss Bell Atlantic's claims that this problem affects 90% of ISP's or USIPA's assertion that "vast majority" of all ISPs borrow their IP addresses from their backbone provider. Since WorldCom and MCI do not recognize a distinction between Internet Backbone Providers and Internet Service Providers, they treat retail ISPs who contract for upstream services and Internet backbone provision as dedicated access customers. They do, however, recognize that changing ISPs may be somewhat more involved for smaller dedicated access customers that are provided with IP addresses by their ISP. But according to MCI and WorldCom, many of these customers are now using the Dynamic Host Configuration Protocol (DHCP) and other means which eliminate the need to configure IP addresses in individual computers. Consequently, the potential for lock-in due to high switching costs affects only a small subgroup of dedicated access customers that may not yet have adopted, but could readily adopt, measures that would facilitate changing IP addresses. They claim that customers who are directly connected to an ISP and do not have portable IP addresses have tools available to facilitate IP address changes. The ability to lock-in customers because of the costs associated with changing IP addresses is a non-issue, according to WorldCom and MCI (January 26, 1998).

This dispute might be easily resolved by investigating whether most ISPs use Dynamic Host Configuration Protocol and if not how costly would it be for them to install it or a similar product. Again, this issue could be resolved with the assistance of engineers who are expert in IP address configuration and the associated costs in changing IP addresses. It cannot, however, simply be ignored or dismissed.

Does WorldCom's Ownership of Five NAPs Create Market Leverage? Bell Atlantic (1998) argues that because WorldCom owns five NAPs, including the two dominant NAPs, MAE East and MAE West, these bottleneck points will give WorldCom MCI leverage over other

Internet Backbone Providers. Bell Atlantic reports that WorldCom's MAE East in Washington, D.C. handles more than 60 percent of all worldwide traffic, an estimated 85 percent of all intra-European traffic, and roughly 40 percent of U.S. Internet traffic. As owner of five NAPs, WorldCom has the ability to influence the terms by which traffic is shared, not only between its network and other networks, but among other networks as well. A backbone provider or ISP cut off from a WorldCom NAP could be in dire straits since other NAPs are overwhelmed with traffic and congestion. Ownership of these facilities gives WorldCom enormous influence in the marketplace, according to Bell Atlantic. No other backbone has this sort of control; only one other backbone, Sprint, is in direct control of even a single NAP, the New York NAP located in New Jersey which handles less traffic than either MAE East or MAE West. These unregulated bottleneck points, according to Bell Atlantic, give WorldCom leverage over other Internet backbone providers[1]

WorldCom and MCI (1998) respond that the merger will have no effect on Network Access Points. First, MCI owns no NAPs. Second, no NAP is a bottleneck because low barriers to entry have led to a steady increase in the number of NAPs. In late 1994, there were four U.S. NAPs today there are 39 NAPs in the U.S. ISPs have a wide variety of NAPs to which they could link. Any attempt by WorldCom pre-merger, or MCI WorldCom post-merger, to take advantage of ISPs connected to any WorldCom NAP would not confer any competitive advantage. Instead, it would trigger a shift by ISPs to connect to one of multiple other NAPs and could further encourage the continuing proliferation of NAPs. In light of the ease with which an ISP can route around a NAP, the ease with which new NAPs can be and have been created, and the lack of any connection between the merger and consolidation of ownership or operation of NAPs, WorldCom and MCI argue that Bell Atlantic's NAP-related contentions do not warrant any further investigation or action.

It is clear from our research, that not all NAPs are created equal. It appears that at the major NAPs, such as MAE East and MAE West, the large Internet Backbones Providers peer with one another and smaller backbones and ISPs interconnect. The presence of the major

backbone providers in one location may confer a market advantage on the owner of the NAP. Furthermore, regulators need to address a number of questions before reaching a conclusion on the issue of market leveage. Does a single peering location occur because of network efficiency considerations, and if so, do these efficiency considerations provide the NAP owner with any pricing power? Or, since there is a relative proliferation of NAPs, is there relatively costless movement without any offsetting efficiency losses? Is the size of a NAP a source of market power arising from increased interconnection options or are there disadvantages due to increased congestion? As NAPs become congested, can the major backbone providers move to private interconnection locations that insure higher quality connectivity for themselves and lower quality connections for their competition? Again, these question could be answered by engineers within the industry.

Is There Any Evidence of Anti-Competitive or Collusive Behavior? Last Spring UUNet, a WorldCom subsidiary, instituted a new "peering" policy that canceled free interconnection for smaller Internet Backbones. In May 1997, according to Bell Atlantic, WorldCom began charging smaller ISPs and backbone networks not only for Internet transit, but simply for access to its customer routes. Backbones and ISPs who refused to pay the fees for customer routes were told that they would not be able to reach WorldCom's customers. Perhaps as many as 30 small backbones and ISPs were notified that WorldCom intended to discontinue peering at various dates in late May and early June. Additionally, in order to negotiate a new agreement, they needed to sign a five year non-disclosure agreement just to be quoted a price from UUNet (Rickard June 1997). UUNet was the subject of widespread condemnation by the communications and Internet press and the Internet community. By the end of the year relatively few ISPs had been de-peered. In many cases UUNet backed off, because of the bad publicity (Cook Report 1998). In other cases, the ISPs eventually capitulated because they had no choice. MCI, BBN, and Sprint then began charging smaller backbones too (Bell Atlantic 1998).

Some observers also detected collusion between WorldCom, Sprint, and others in announcing the end for free peering (Rickard 1997 and Cook Report 1998). Rickard stated:

> "while it appears to be UUNET, we have already amassed sufficient evidence of collusion from PSI and SPRINT to probably send someone to jail, but in any event sufficient to pull together a really interesting class action lawsuit that could potentially cripple all three companies. (Jack Rickard, June 1997,*Boardwatch Magazine).*

There is no evidence, however, that a class action lawsuit was ever filed.

WorldCom's logic for its new peering policy was based on the recognition that its backbone network had grown bigger than most others. If the merger is approved, WorldCom will have no equals. If WorldCom enforces its current interconnection standards after the merger, even Sprint can expect WorldCom to stop freely peering with its networks. And at that point, customers would have little incentive to switch to a competing backbone provider, since all prices ultimately will be regulated by WorldCom through the prices it charges for peering.

WorldCom and MCI respond that peering should be viewed as involving payment in kind, a barter arrangement, that makes sense when the peers exchange roughly comparable amounts of traffic. Otherwise, an access fee should be paid from the smaller to larger provider, when the smaller provider wants to utilize the larger providers network or to reach a greater number of customers. The companies argue that any attempt to impose unreasonable conditions on interconnection would simply cause the affected provider to utilize alternative means to reach MCI and WorldCom's customers, which would only increase of revenues MCI and WorldCom's competitors.

Undoubtedly, speaking from recent experience, WorldCom and MCI find it hard to imagine a more certain way to destroy a company's reputation than to make it difficult for other ISPs and their customers to exchange traffic with MCI and WorldCom and its customers, or to refuse to interconnect on reasonable terms. In retrospect it appears that the attempt to do so was simply ill-advised. The company greatly damaged its reputation, as web pages, bulletin boards, and chat rooms mobilized the Internet community to oppose the heavy hand of UUNet. Sprint's involvement in the cancellations (Rickard 1997) along with allegations about the five large

peering backbones (Cook Report 1998) raise questions about tacit collusion among the large Internet Backbone Providers. Allegations about tacit collusion could be ignored in this merger review, were it not for the substantial evidence of tacit collusion in the pricing of publicly switched long distance service among AT&T, MCI, and Sprint (MacAvoy 1996), which could be easily replicated in the pricing of Internet Backbone service by WorldCom-MCI and Sprint.

Summary. There is a need to determine whether WorldCom's and MCI's control over IP addresses locks-in ISPs into depending on their upstream service. This can be accomplished by investigating whether most ISPs use Dynamic Host Configuration Other questions that need to be investigated include whether the presence of all major backbone providers confer any market advantage for a NAP; whether a single peering location occur because of network efficiency considerations provide the NAP owner with any pricing power; or whether the size of a NAP a source of competitive advantage or disadvantage due to increased congestion. Finally, the evidence on whether there has been tacit and overt collusion between WorldCom, MCI, and Sprint in signing interconnection agreements, canceling peering, or inhibiting peering needs to considered and confirmed or refuted during the review process.

The Merger and Dynamic Internet Growth and the Ease of Competitive Entry

WorldCom and MCI argue that the merger will do nothing to slow the dynamic growth of the Internet or diminish the vigorous competition among Internet service providers. There can be no doubt concerning the Internet's rapid growth and the ease of entry. In less than two years, the number of Internet Service Providers grew from 1,447 in February 1996 to 4,354 in October 1997. In the last three years the number of Network Access Points went from 4 to 39, and the number of Internet Backbone Providers has dramatically increased from a small handful to three dozen. Internet revenue has grown from an estimated $1.85 billion in annualized revenue as of April 1996, to $8.4 billion in annualized revenue as of October 1997 (Maloff Report 1997; cited by Carlton and Sider 1998). With the development of the World Wide Web the demand for

Internet connections exploded. Local telephone companies were taken by surprise as record numbers of consumers demanded second lines, so they could connect to their Internet Service Provider. New Internet products are now being readied for deployment including Internet fax, Internet voice mail, Internet telephony, and Internet interactive video. There are increasing predictions that the packet switched Internet will eventually replace the circuit switched public telephone network. WorldCom and MCI assure us that the merger cannot harm competition in the provision of Internet services.

Even some experts who express concerns about the anti-competitive motives behind MCI-Worldcom merger remain confident that the decentralized, highly competitive Internet environment is sufficiently robust to undermine any efforts of the merged company to exercise market power (Maloff 1997, Rickard 1998). However, with the rapid growth in Internet products, customers, and traffic there has to be sufficient bandwidth availability to provide wholesale services and backbone connectivity. Otherwise, the Internet will experience congestion, which creates the opportunity for mischief and market failure.

MCI and WorldCom assure us that there are no significant barriers to capacity expansion by either incumbent network providers or new firms building networks. They report that new national, high capacity fiber optic networks are currently being deployed and new entrants have recently announced plans for more network deployments. They predict that within two years there will be seven national fiber optic networks with abundant capacity to support Internet growth and development. Only four, however, currently exist, which will become three if the merger is approved- AT&T, MCI-WorldCom, and Sprint; two are currently under construction by Qwest and IXC; and two have been announced by Level 3 and Williams. Other announcements have since followed by GTE and Frontier. The merger, however, will eliminate the nation's fourth largest fiber optic network, WorldCom and merge it into MCI's, which is the nation's second largest network.

MCI and WorldCom believe that only possible source of a competitive issue presented by the MCI-WorldCom merger arises from the transmission facilities that will be controlled by

the merged company that provide Internet service (1998).[2] That is because after the merger, except for Sprint's facilities, all other backbones will either be owned by WorldCom-MCI or will operate on facilities leased from WorldCom-MCI (Rickard 1998). WorldCom is currently the leading supplier of telecommunication network facilities for lease to the Internet. By allowing it to merge with MCI, one of two other Internet national network suppliers, Sprint will become the only national network alternative to WorldCom-MCI. The other likely candidate, AT&T, has not participated in the Internet wholesale market. When it launched AT&T World Partners, for example, it relied on BBN to provide its backbone services; AT&T has participated only at the retail level of the Internet market.

To alleviate any concern about a merged WorldCom-MCI's control over transmission facilities WorldCom, MCI, and their experts, Carlton and Sider, focus on the expansion plans of the other potential network providers. The current telecommunications interexchange market is highly concentrated. The top 4 companies owned 97% of the total communications plant at the end of 1996 (Table 6). WorldCom is the only national network provider operating outside the framework of the big three, AT&T, MCI, and Sprint. Since WorldCom is not a brand name long distance provider, it leases most of it facilities, and much of those leased facilities carry Internet traffic. The new competitors will also lease their facilities. WorldCom and MCI are convinced the new entrants will supply them with effective competition. However, competitors, such as IXC and Qwest, accounted for only 3 percent of the total communications plant and less than 5 percent of the total fiber route miles in 1996. IXC owned less than one-half of one percent of the total interexchange carrier plant in 1996.